HIGH ACID SYSTEM NUTRITIONAL FORMULATIONS

This is a continuation of application Ser. No. 07/809,852, filed Dec. 18, 1991, now abandoned, which in turn is a continuation of application Ser. No. 07/608,072, filed Nov. 1, 1990, now abandoned.

This invention relates to improved liquid nutritional formulations. More particularly, it relates to improved liquid oral nutritional supplement formulations.

FIELD OF THE INVENTION

There are numerous oral nutritional supplements on the market. However, currently all are low acid (high pH) dairy based products; typically vanilla, chocolate or strawberry flavored at present. There are no ready-to-drink nutrition supplements providing alternatives to these "milky tasting products". The present invention provides liquid oral nutritional formulations which have a juice-like consistency and flavor.

SUMMARY OF THE INVENTION

The present invention provides improved liquid oral nutritional formulations. The improved formulations are comprised based on the total formulation calories of about 40 to 90% of calories as carbohydrates, about 2 to 30% of calories as protein, about 0 to 35% of calories as fat, and about 0 to 17% of calories as fiber. The formulations may also contain 100% of U.S. RDA of vitamins and minerals. The formulations have a high acid (low pH) content (e.g., pH3.5–3.9). The formulations may be carbonated or non-carbonated. The present formulations are preferably used as an oral nutritional supplement providing about 1.0 calorie/ml.

DETAILED DESCRIPTION OF THE INVENTION

The carbohydrate source may be sucrose, corn syrup solids, glucose, fructose, maltodextrin or combinations thereof. Sucrose is preferred. When using corn syrup solids or maltodextrin, it is preferred that they be used in combination with either sucrose, glucose or fructose, or combinations of sucrose, glucose or fructose with the corn syrup solids or maltodextrin content of the combination being less than about 40% of the total combination. Also, combinations of corn syrup solids and maltodextrin may be used with either sucrose, glucose, fructose, or combinations of sucrose, glucose or fructose provided that the combination of corn syrup solids and maltodextrin is less than about 40% of the total combination. Concentrations of corn syrup solids, maltodextrin or combinations thereof, are maintained below 40% of the total carbohydrate source to minimize Maillard browning.

Artificial sweeteners e.g., saccharin and aspartame, may also be used to enhance the organoleptic quality of the formulations.

The amount of carbohydrate may preferably be from about 60% to 85% of total formulation calories.

The protein source may be whey protein concentrate (whey), caseinate, soy protein, egg whites or combinations thereof. Whey is preferred because of its good flavor, and solubility at low pH. Caseinate, soy protein and egg white may used in combination with the whey, at a concentration of at least 60% whey. At concentrations above 40%, caseinate and soy protein tend to precipitate and impart a poor taste to the formulations, whereas egg whites at concentrations above 40% tend to gel at processing temperatures.

The amount of protein may be preferably from about 5–25% of total formulation calories.

The fat source of the formulations may be any fat source or blend of fat sources which provide the desired amount of fat calories. Preferably the fat source should be high in monounsaturated fatty acids. Fat sources may include vegetable oils, e.g., high oleic acid vegetable oils such as sunflower oil, canola oil, and olive oil; safflower oil, cottonseed oil, corn oil or soybean oil, and medium chain triglycerides e.g., C6–C12 triglycerides. High oleic acid sunflower oil is preferred.

Marine oils and butter fat may also be used.

The fat source may preferably be from about 0 to 25% of the total formulation calories.

The fiber source may be guar gum, pectin, soy polysaccharide, gum arabic and the like or combinations thereof. Guar gum and pectin are preferred. The fiber may preferably be from about 0–5% of the total formulation calories.

It has been found that during heat processing and storage time a high ion concentration, especially sodium ion and potassium ion, causes gellation of the protein of the formulations. To overcome this problem, the potassium content of the formulations is limited to about 0 to 10 mg per 100 ml (0 to 23.7 mg per 8 oz); and the sodium content of the formulations is limited to about 0 to 30 mg per 100 ml (0 to 71.1 per 8 oz). It will be understood that the sodium and potassium ions are supplied naturally (without added salts) by adjusting the combination of carbohydrates and protein.

The presence of reducing sugars and protein (which contain alpha amino acid groups) makes the formulations susceptible to nonenzymatic browning, which causes an undesirable color and unpleasant flavor. This browning effect may be reduced by maintaining the formulations at a low pH of 3.5–3.9. Further reduction in nonenzymatic browning without pH change may be achieved by the addition of cysteine, which inhibits this reaction, or by the use of sucrose, a non reducing sugar, or a combination of both.

Acids such as phosphoric acid, citric acid, malic acid, tartaric acid, fumaric acid, adipic acid, lactic acid, or combinations thereof, may be used for pH control. However, the combination of phosphoric acid and citric acid is preferred. A ratio of citric acid to phosphoric acid of 1 to 1.9 preferably 0.77 to 1.0 may be so used for pH control.

To inhibit nonenzymatic browning, cysteine may be added in free form from about 0.025 to 0.20% on a weight/weight (w/w) basis, based on the total weight of the liquid formulation. The preferred amount is from about 0.04% to 0.1% (w/w).

Free amino acids may be added to the present formulations for nutritional benefits. Supplementation with free amino acids normally imparts a detrimental flavor to nutritional products. However, amino acids such as arginine, cysteine, isoleucine, leucine, valine or combinations thereof may be added to the present formulations without negative flavor impact due to the present low pH system.

The amino acids are preferably added from about 0 to 1.0% (w/w) basis, based on the total weight of the liquid formulation.

The following Tables I, II and III illustrate preferred nutritional formulations.

Table I shows the nutritional profile of formulations with and without fat. Table II lists the actual ingredients of .the